SECTION 10 – TURBIDITY

SUMMARY

As a result of the 1998-1999 SWQB/NMED monitoring effort in the Jemez River Basin, several exceedances of New Mexico water quality standards for turbidity were documented on Redondo Creek, San Antonio Creek, East Fork of the Jemez River, and Clear Creek. Figures 5.B.1 and 5.B.2 in Section 5 show the land use/cover and land ownership percentages for Redondo Creek (from its mouth on Sulphur Creek to the headwaters). Similarly, Figures 5.C.1, 5.C.2, 5.D.1, 5.D.2, 5.H.1 and 5.H.2, also in Section 5, show the land use/cover and land ownership percentages for San Antonio Creek (from its confluence with East Fork of Jemez River to the headwaters), East Fork of Jemez River (from its confluence with San Antonio Creek to the headwaters), and Clear Creek (from its confluence with Rio de las Vacas to San Gregorio Reservoir), respectively. These streams were also listed in the 2000-2002 §303(d) list for turbidity. Detailed descriptions of these stream segments can be found in subsections B, C, D, and H, Section 5 of this document.

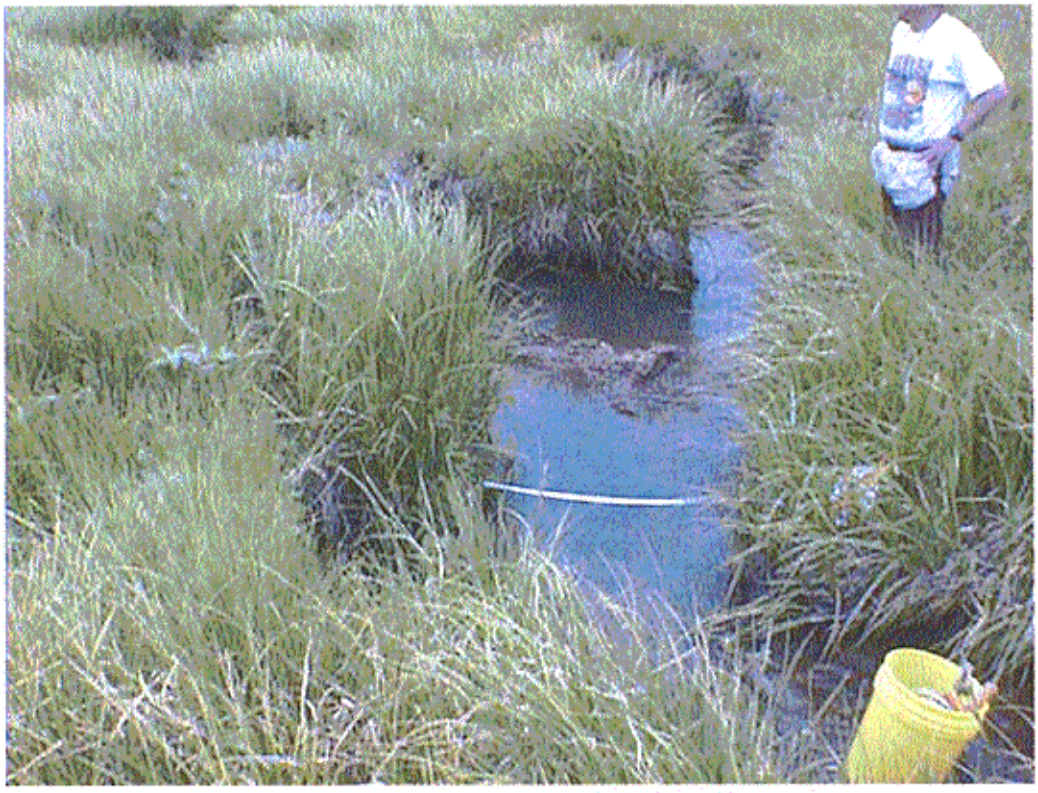


Photo 24. Redondo Creek (NMED Sampling Station 11 – Thermograph T10

ENDPOINT IDENTIFICATION

Target Loading Capacity

Overall, the target values for this TMDL will be determined based on 1) the presence of numeric criteria, 2) the degree of experience in applying the indicator, and 3) the ability to easily monitor and produce quantifiable and reproducible results. For this TMDL document target values for turbidity are based on numeric criteria. This TMDL is consistent with the State's antidegradation policy.

Turbidity

According to the New Mexico water quality standards (20.6.4.12.J NMAC), the narrative standard for turbidity reads, "Turbidity attributable to other than natural causes shall not reduce light transmission to the point that normal growth, function, or reproduction of aquatic life is impaired or that will cause substantial visible contrast with the natural appearance of the water."

The State's standard leading to an assessment of use impairment is the numeric criterion for turbidity of 25 NTU for a High Quality Coldwater Fishery (HQCWF) and Coldwater Fishery (CWF). Turbidity levels can be inferred from studies that monitor total suspended sediment (TSS) concentrations. Extrapolation from these studies is possible because of the relationship between concentrations of suspended sediments and turbidity. Activities that generate varying amounts of suspended sediment will proportionally change or affect turbidity (USEPA, 1991). In these watersheds both TSS and turbidity were measured. A strong correlation ($R^2 = 0.95$) was found between TSS and turbidity for Redondo Creek (Figure 10-1) and also for San Antonio Creek ($R^2 = 0.84$)(Figure 10-2). In addition, the East Fork of Jemez River (Figure 10-3) produced a strong correlation ($R^2 = 0.88$), while Clear Creek (Figure 10-4) did not ($R^2 = 0.1$). Figures 10-1 through 10-4 are located at the end of this section.

Flow

Sediment movement in a stream varies as a function of flow. As flow increases the concentration of sediment increases. This TMDL is calculated for each reach at a specific flow. When available, US Geological Survey gages are used to estimate flow. Where gages are absent, geomorphological cross sectional information is taken at each site and the flows are modeled. Gaged streamflow data is not available for Redondo Creek, San Antonio Creek, East Fork of the Jemez River and Clear Creek. Cross sectional data was taken for each stream reach in order to estimate stream discharge using procedures from USGS Technical Paper 2193, *Streamflow Characteristics Related to Channel Geometry of Streams in Western United States* (USGS, 1983), and the channel cross-section analyzer WinXSPRO® (FS, 1998).

Following USGS procedures (USGS, 1983), average annual discharge is calculated using the following regression equation:

$$Q_A = 64 W_{ac}^{1.88}$$

where,

Q_A = acre-feet/yr and W_{ac} = width of the active channel (width at bankfull) in feet

Utilizing the cross sections at the end of this section (SWQB/NMED field data, 1998), the width of Redondo Creek, San Antonio Creek, East Fork of the Jemez, and Clear Creek at bankfull is 3.1, 24.5, 30.5 and 12.0 feet, respectively. The calculations are shown below for each stream.

REDONDO CREEK:
$Q_A = 64(3.1)^{1.88}$
Q_A = 537 acre feet/year
Q_A = 0.74 cfs
Q_A = 0.48 MGD

SAN ANTONIO CREEK:
$Q_A = 64(24.5)^{1.88}$
Q_A = 26,171 acre feet/year
Q_A = 36.2 cfs
Q_A = 23.4 MGD

EAST FORK OF THE JEMEZ RIVER:
$Q_A = 64(30.5)^{1.88}$
Q_A = 39,506 acre feet/year
Q_A = 54.7 cfs
Q_A = 35.4 MGD

CLEAR CREEK:
$Q_A = 64(12.0^*)^{1.88}$
Q_A = 6,840 acre feet/year
Q_A = 9.5 cfs
Q_A = 6.1MGD

* Estimated from field observations

Average discharge is defined as that flow rate which if continued every day of the year, would yield the observed annual volume of water. The average discharge usually fills a channel to approximately one-third of the channel depth, and this flow rate is equaled or exceeded approximately 25% of the days in a year (Leopold et al., 1964).

Average discharge is characterized by five attributes, which make it ideal for TMDL modeling:

1. Approximately 75% of the time, flows are less than the average discharge.
2. Volume carried by these flows amounts to only 25% of the annual volume.
3. It can be easily modeled.
4. It's the discharge average for 365 days (one year).

The cross section of the channel and adjacent floodplain is key to predict velocity and water surface stage elevation during high and low flow events. It is important to remember that the TMDL is a planning tool to be used to achieve water quality standards. Since flows vary throughout the year in these systems the target load will vary based on the changing flow. Management of the load should set a goal at water quality standards attainment; not meeting the calculated target load.

Calculations

Target loads for turbidity (expressed as TSS) are calculated based on flow, current water quality standards, and a unit-less conversion factor (8.34) that is a used to convert mg/L units to lb/day (see Appendix A for conversion factor derivation). The target loading capacity is calculated using Equation 1 and results are shown in Table 10-1.

Equation 1.

Critical Flow (MGD) x Standard (mg/L) x 8.34 (conversion factor) = Target Loading Capacity

Table 10-1: Calculation of Target Loads

Location	Flow+ (MGD)	TSS (mg/L)	Conversion Factor	Target Load (lbs/day)
Redondo Creek	0.48	24.0 *	8.34	96.1
San Antonio Creek	23.4	18.2 *	8.34	3,551.8
East Fork of the Jemez River	35.4	8.0 *	8.34	2,361.9
Clear Creek	6.1	25 **	8.34	1,271.9

+Since USGS gages were unavailable on these reaches, flows are modeled using the cross sectional data (included at end of this section) that are used to estimate stream discharge using USGS Technical Paper 2193 (USGS, 1983).
*These values are calculated using the relationship established between TSS and turbidity based on regression equations shown in Figures 10-1 through 10-4 at the end of this section.
**No relationship was established between TSS and turbidity for Clear Creek. A 1:1 relationship is assumed and the value of 25 NTU is translated into 25 mg/L TSS in this case.

The measured loads for turbidity were similarly calculated. In order to achieve comparability between the target loads and the measured loads, the flows used were the same for both calculations. The geometric mean of the data that exceeded the standards from all data collected at each site was substituted for the standard in Equation 1. The data for each stream segment is located in Table 10-6 at the end of this section. The same conversion factor of 8.34 was used. Results for measured loads are presented in Table 10-2 for turbidity.

It was not possible to calculate background loads in this watershed. A reference reach, having similar stream channel morphology and flow, was not found. It is assumed that a portion of the load allocation is made up of natural background loads. In future water quality surveys, finding a suitable reference reach will be a priority.

Table 10-2: Calculation of Measured Loads

Location	Flow+ (MGD)	TSS Geometric Mean* (mg/L)	Conversion Factor	TSS Measured Load (lbs/day)
Redondo Creek	0.48	35.2	8.34	140.9
San Antonio Creek	23.4	29.8	8.34	5,815.6
East Fork of the Jemez River	35.4	36.6	8.34	10,805.6
Clear Creek	6.1	26.7	8.34	1,358.3

+Since USGS gages were unavailable on these reaches, flows are modeled using the cross sectional data (included at end of this section) that are used to estimate stream discharge using USGS Technical Paper 2193 (USGS, 1983).
*These are the geometric means of TSS values that exceeded the numeric standard (Table 10-6)

Waste Load Allocations and Load Allocations

•*Waste Load Allocation*
There are no point source contributions associated with this TMDL. The waste load allocation (WLA) is zero.

•*Load Allocation*
In order to calculate the load allocation (LA), the WLA and margin of safety (MOS) were subtracted from the target capacity (TMDL) using Equation 2. The MOS is estimated to be 25% of the TMDL calculated in Equation 1.

Equation 2. $WLA + LA + MOS = TMDL$

Results using a Margin of Safety (MOS) of 25% (explained further in this section) are presented in Table 10-3 as follows:

Table 10-3: Calculation of TMDL for Turbidity

Location	WLA (lb/day)	LA (lb/day)	MOS 25% (lb/day)	TMDL (lb/day)
Redondo Creek	0	72.1	24.0	96.1
San Antonio Creek	0	2,663.9	888.0	3,551.8
East Fork of the Jemez River	0	1,771.4	590.5	2,361.9
Clear Creek	0	953.9	318.0	1,271.9

The load reductions necessary to meet the target loads were calculated to be the difference between the load allocations (Table 10-3) and the measured load (Table 10-2) and are shown in Table 10-4.

Table 10-4: Calculation of Load Reductions (lb/day)

Location	Load Allocation (lb/day)	Measured Load (lb/day)	Load Reductions (lb/day)
Redondo Creek	72.1	140.9	68.8
San Antonio Creek	2,663.9	5,815.6	3,151.7
East Fork of the Jemez River	1,771.4	10,805.6	9,034.2
Clear Creek	953.9	1,358.3	404.4

Identification and Description of Pollutant Source(s)

Pollutant sources that could contribute to each segment are listed in Table 10-5.

Table 10-5. Pollutant Source Summary

Pollutant Sources	Magnitude (WLA+LA+MOS) (lb/day)	Location	Potential Sources (apply to three segments) (% from each)
Point: None	0	--------	0%
Nonpoint:			100%
	96.1	Redondo Creek	Rangeland
Turbidity	3,551.8	San Antonio Creek	Siviculture, Land development, Natural, Recreation, Removal of Riparian Vegetation, Streambank Modification/ Destabilization.
	2,361.9	East Fork of the Jemez River	Rangeland, Siviculture, Recreation, Streambank Modification/Destabilization.
	1,271.9	Clear Creek	Streambank Modification/ Destabilization

LINK BETWEEN WATER QUALITY AND POLLUTANT SOURCES

Where available data are incomplete or where the level of uncertainty in the characterization of sources is large, the recommended approach to TMDL assignments requires the development of allocations based on estimates utilizing the best available information.

SWQB fieldwork includes an assessment of the potential sources of impairment (SWQB/NMED, 1999). The Pollutant Source(s) Documentation Protocol, shown as Appendix B, provides an approach for a visual analysis of the source along an impaired reach. Although this procedure is subjective, SWQB feels that it provides the best available information for the identification of potential sources of impairment in this watershed. Table 10-5 (Pollutant Source Summary) identifies and quantifies potential sources of nonpoint source impairments along each reach as determined by field reconnaissance and assessment.

MARGIN OF SAFETY (MOS)

TMDLs should reflect a margin of safety based on the uncertainty or variability in the data, the point and nonpoint source load estimates, and the modeling analysis. For this TMDL, there will be no margin of safety for point sources, since there are none. However, for the nonpoint sources the margin of safety is estimated to be an addition of 25% for turbidity (SWQB/NMED, 2000) to the TMDLs, excluding background. This margin of safety incorporates several factors:

- *Errors in calculating NPS loads*

  A level of uncertainty exists in sampling nonpoint sources of pollution. Accordingly, a conservative margin of safety for turbidity increases the TMDL by 15%.

- *Errors in calculating flow*

  Flow estimates were based on estimated mean average discharge using cross sectional information found at the end of this section (SWQB/NMED field data) and USGS Technical Paper 2193 (USGS, 1983). To be conservative, an additional 10% will be included to account for accuracy of flow measures.

CONSIDERATION OF SEASONAL VARIATION

Data used in the calculation of this TMDL were collected during spring, summer, and fall of 1998 in order to ensure coverage of any potential seasonal variation in the system. It is assumed that if the critical conditions are met, coverage of any potential seasonal variation will also be met.

FUTURE GROWTH

Estimations of future growth are not anticipated to lead to a significant increase for turbidity that cannot be controlled with best management practice implementation in this watershed.

TABLE 10-6: TURBIDITY AND TSS RESULTS DURING 1998-1999 SAMPLING EFFORT

	Station 11 - Redondo Creek		Station 9 - San Antonio Creek (lower)		Station 10 - San Antonio Creek (middle)	
Sampling date	**Turbidity (NTU)**	**TSS (mg/L)**	**Turbidity (NTU)**	**TSS (mg/L)**	**Turbidity (NTU)**	**TSS (mg/L)**
4/20/1998	16.5	8	21	14	22.8	13
4/21/1998	16.2	6	24.4	18	22.8	13
4/22/1998	17.2	8	* 26.2	23	* 26.5	17
4/23/1998	* 29.5	24	* 31.3	23	* 27.5	21.5
7/13/1998	* 42.1	63	17.5	19	8.4	< 3
7/14/1998	17.9	10	14.2	11	7.9	< 3
11/2/1998	11.9	< 3	* 33.9	22	* 34.7	28
GEOMETRIC MEAN OF EXCEEDANCES --->	38.9		22.2			

	Station 8 - East Fork of the Jemez River	
Sampling date	**Turbidity (NTU)**	**TSS (mg/L)**
4/20/1998	19.5	4
4/21/1998	19.8	3
4/22/1998	18.6	5
4/23/1998	20	4
7/13/1998	* 42.6	22
7/14/1998	12.4	< 3
11/2/1998	* 31.5	9
GEOMETRIC MEAN OF EXCEEDANCES --->	14.1	

	Station 22 - Clear Creek	
Sampling date	**Turbidity (NTU)**	**TSS (mg/L)**
7/13/1998	12.4	4
7/14/1998	13.7	10
7/15/1998	14.3	5
7/16/1998	15.2	3
11/2/1998	* 27.5	6
11/3/1998	* 26.8	< 3
11/4/1998	* 25.9	< 3
GEOMETRIC MEAN OF EXCEEDANCES --->	3.8	

* Exceedance

NOTE: The geometric mean of exceedances is the geometric mean of TSS values when the turbidity standard is exceeded (25 NTU)

FIGURE 10-1
RELATIONSHIP BETWEEN TURBIDITY AND TOTAL SUSPENDED SEDIMENT

REDONDO CREEK

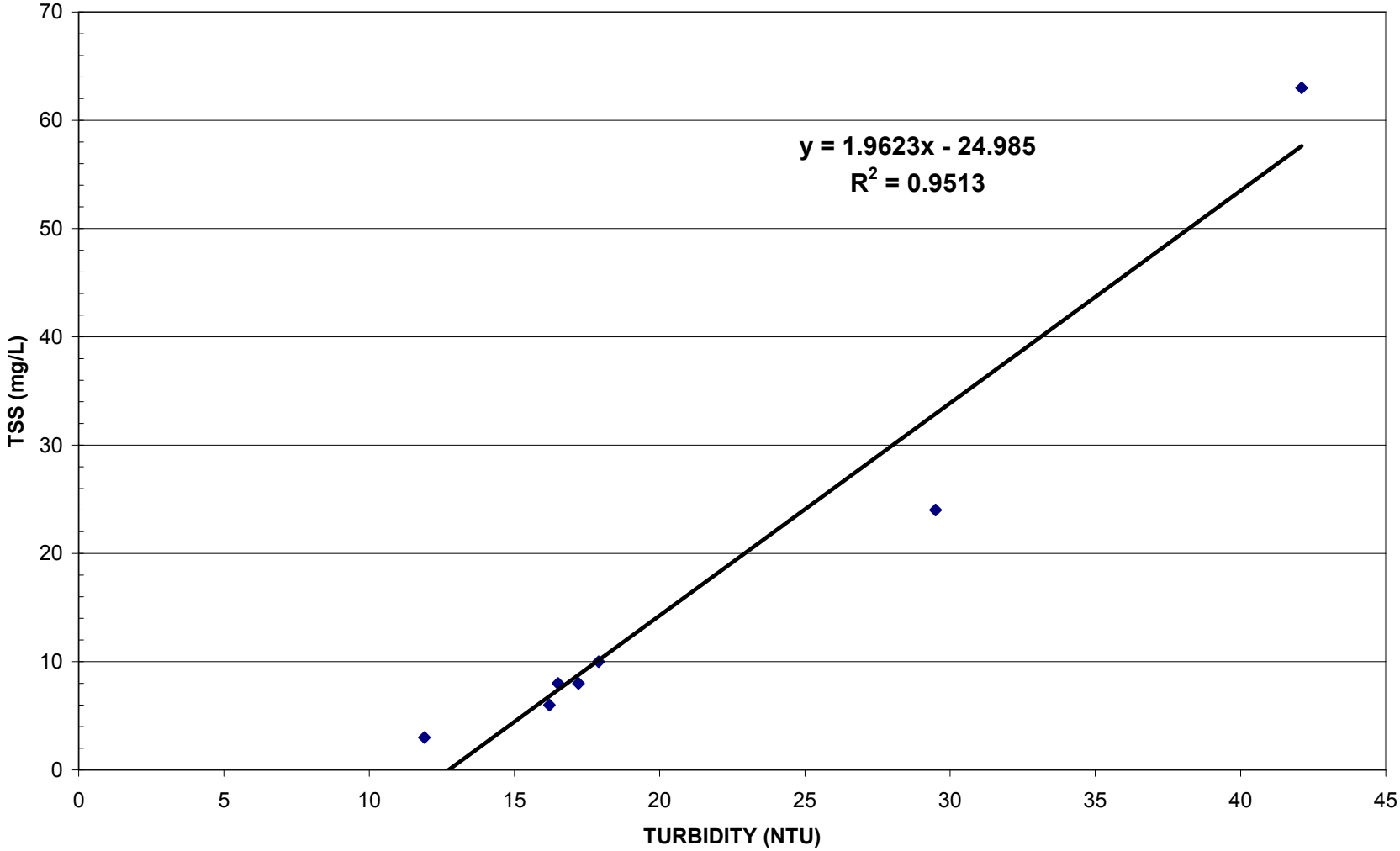


FIGURE 10-2
RELATIONSHIP BETWEEN TURBIDITY AND TOTAL SUSPENDED SEDIMENT

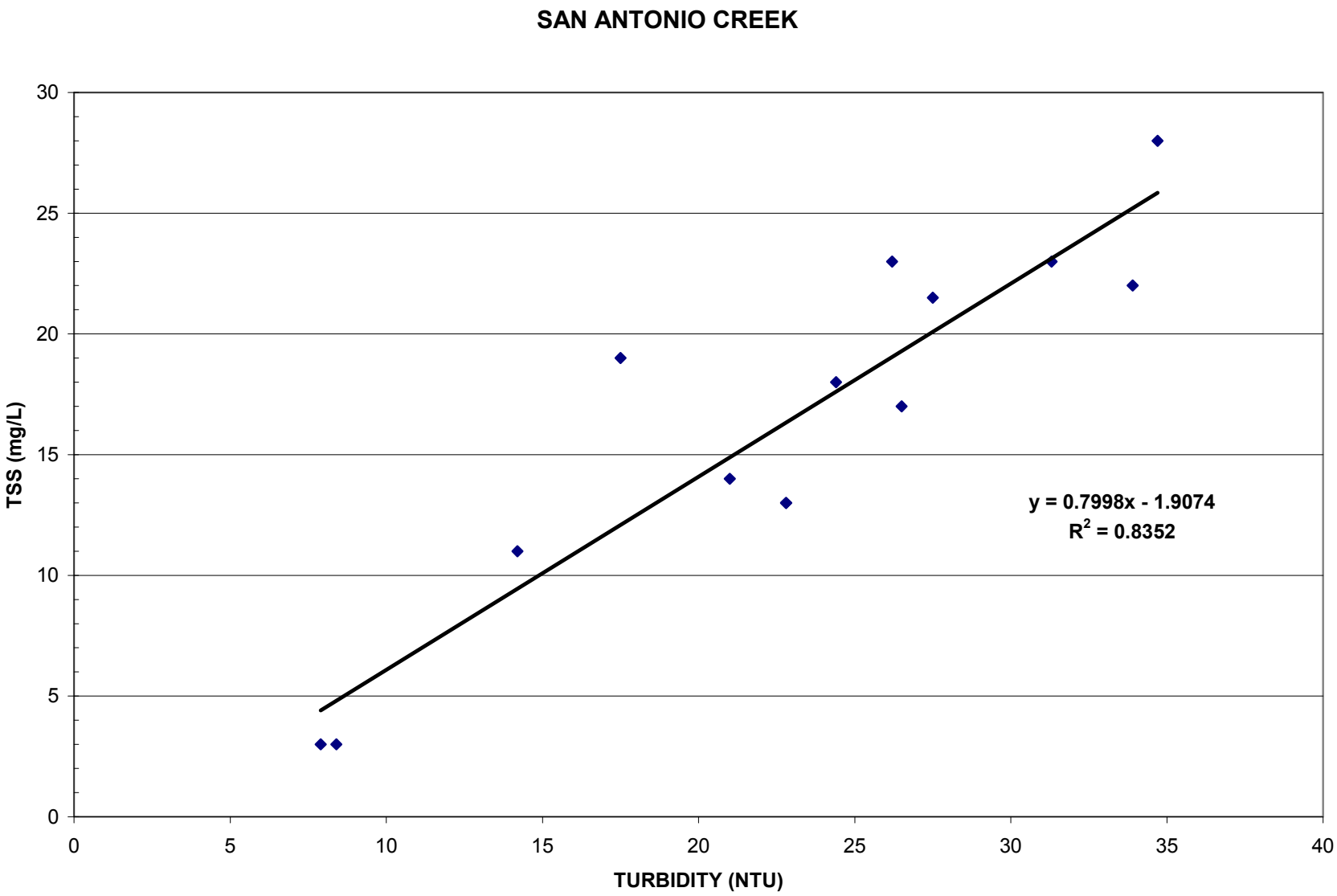


FIGURE 10-3
RELATIONSHIP BETWEEN TURBIDITY AND TOTAL SUSPENDED SEDIMENT

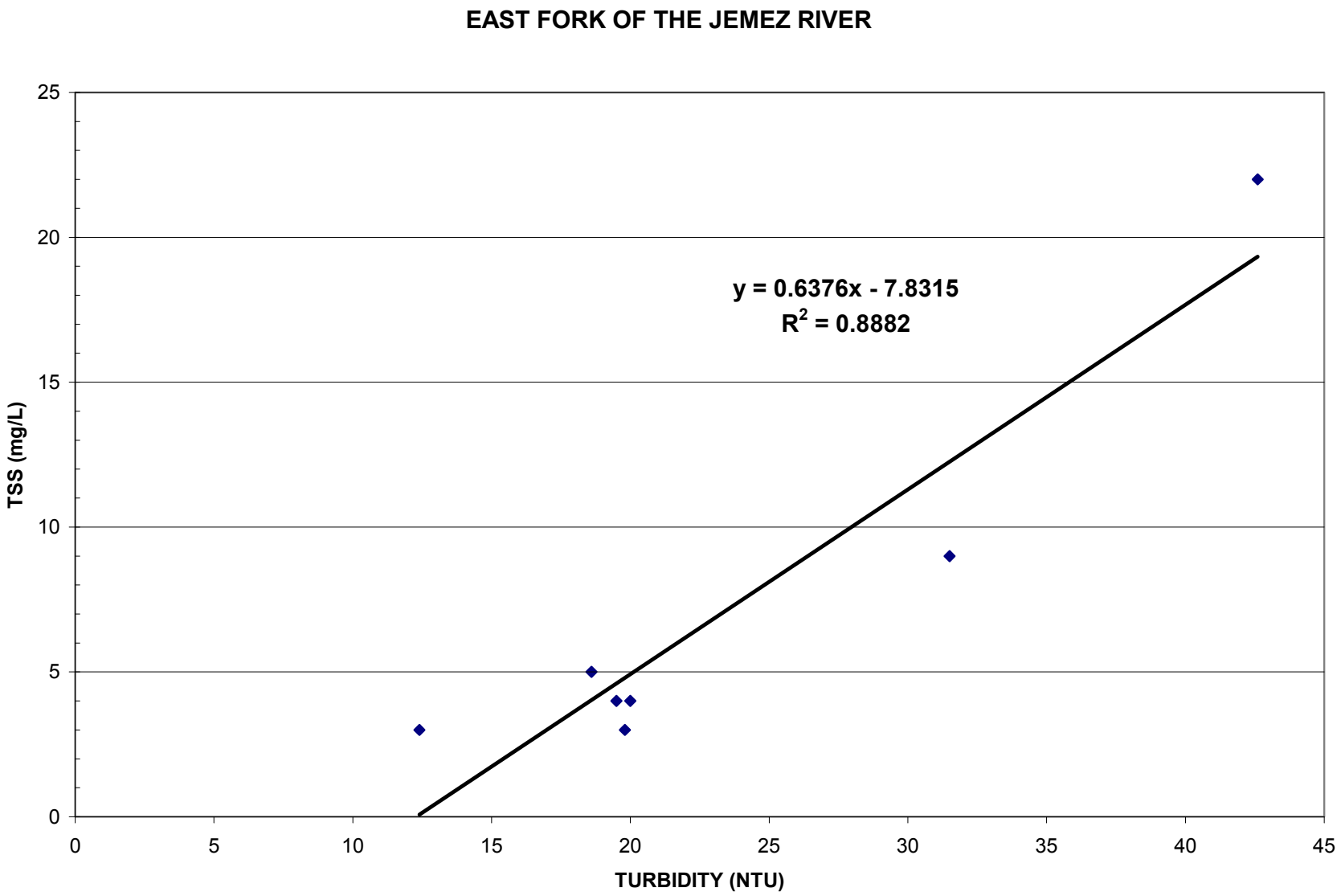
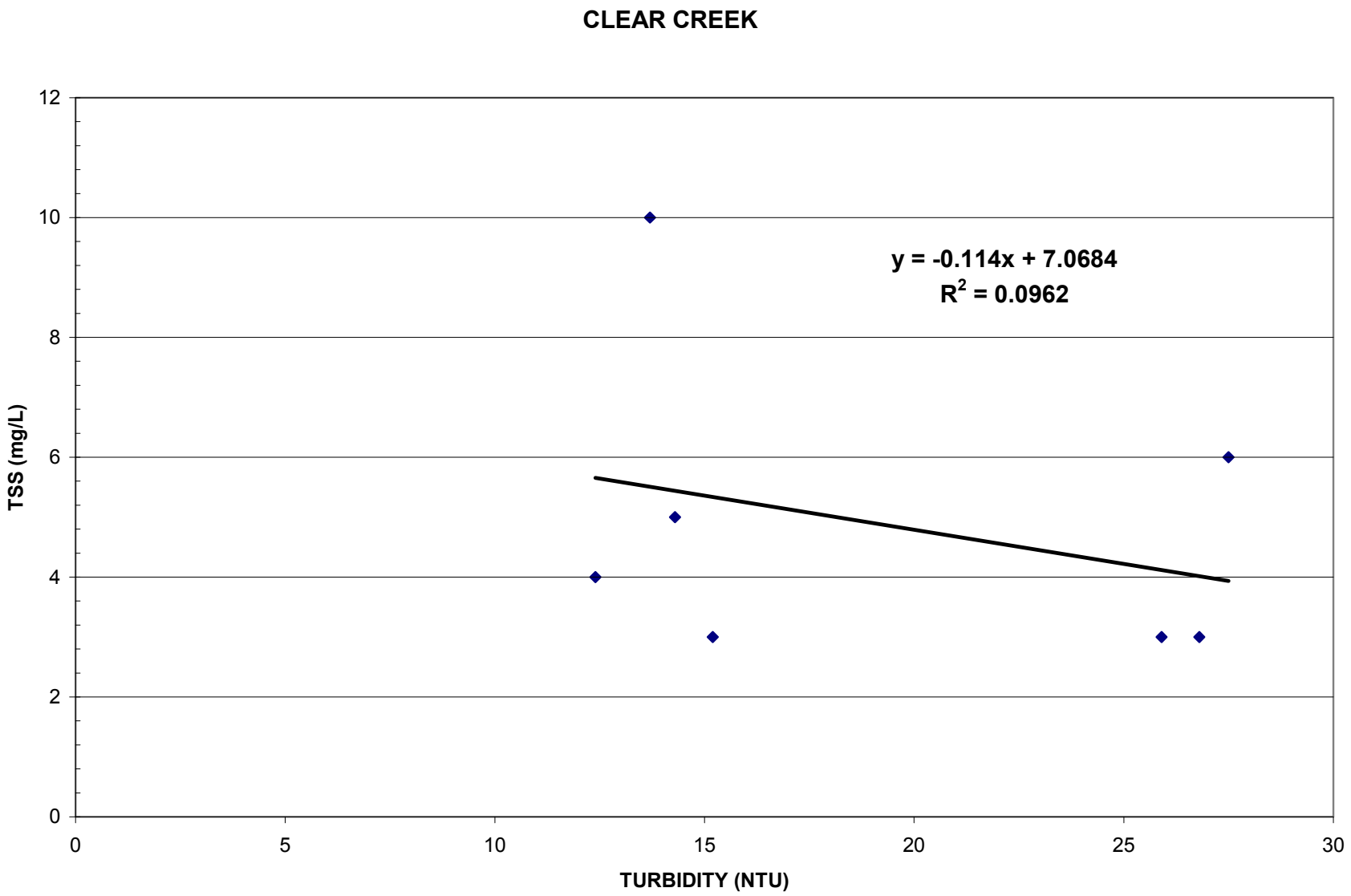


FIGURE 10-4
RELATIONSHIP BETWEEN TURBIDITY AND TOTAL SUSPENDED SEDIMENT



THE REFERENCE REACH FIELD BOOK

RVEY DATA ⇒ CROSS - SECTION Part I

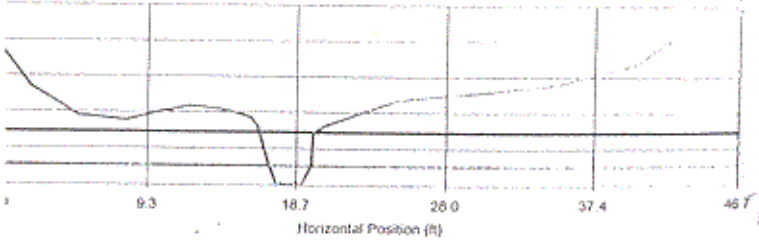
GE: Redondo @ Lv. Sullivan No: 7

cation: Date: 6/22/99

y / Notes: LRS VT

tance:

istance	Height	Adjusted Height	Notes
0.00	7.27	100	LBP
2	7.98	99.29	
5	8.48	98.79	
8	8.56	98.71	
10	8.42	98.85	
12	8.31	98.96	
14	8.37	98.9	
15.8	8.5	98.77	top of bank
16.2	8.63	98.64	
16.7	8.76	98.51	left bankfull
16.8	8.78	98.49	bank edge
17	9.38	97.89	left water edge
17.4	9.6	97.67	
17.8	9.62	97.65	
18.2	9.65	97.62	thalwag
18.6	9.59	97.68	
19	9.63	97.64	
19.6	9.38	97.89	rt. Water edge
19.75	8.76	98.51	Rt. Bank full
20.5	8.64	98.63	top of bank
25	8.2	99.07	
30	8.07	99.2	
35	7.92	99.35	
40	7.57	99.7	
42.5	7.05	100.22	
46.7	6.56	100.71	rt. Bank pin

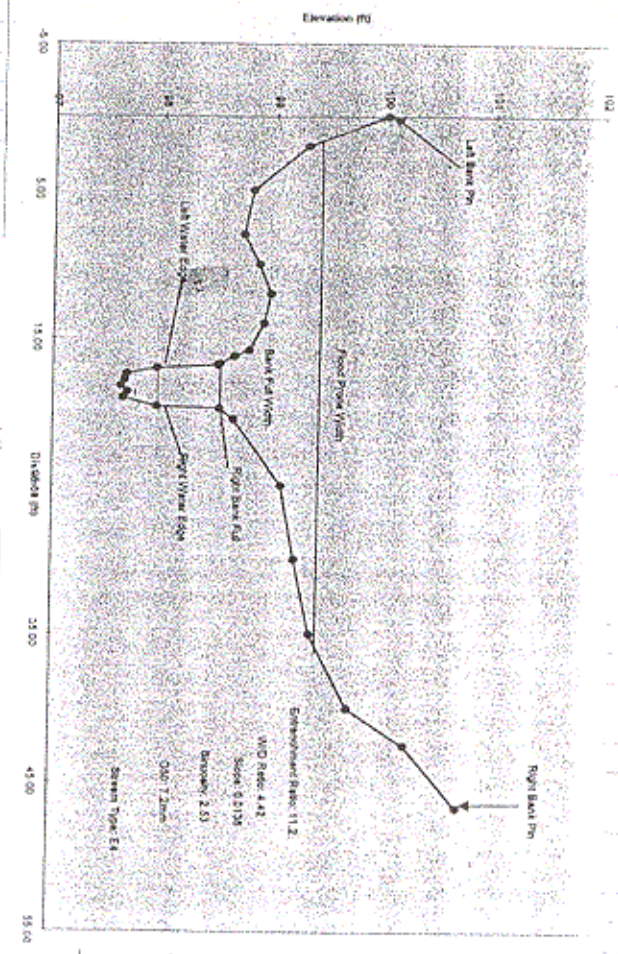


THE REFERENCE REACH FIELD BOOK 137

SURVEY DATA ⇒ CROSS - SECTION Part II

GAGE: No: Date:

STATION	BS	HI	FS	Elevation	NOTES	COMMENT	REMARKS



REDONDO ABV SULPHUR

Date/

Dist. from Bank	Width	Depth	Area	RPM	Velocity	Q
.25	.5	.35	.175		1.09	0.191
.75	↓	.35	.175		.95	.166
1.25		.35	.175		.80	.14
1.75	↓	.40	.177		1.12	.198
						.694

$\bar{X}$ =

.25	.5	.50	.25		.76	.19
.75	.5	.55	.275		.54	.149
1.25	.5	.60	.3		.76	.23
1.75	.5	.60	.3		.99	.30
						.866

$\bar{X} = .78$

```
Input file:                 C:\WXSPRO20\REDRWE9.DAT
Run Date:                   06/29/99
Analysis Procedure:         Hydraulics
Cross Section Number:       1
Survey Date:                06/28/99

Subsections/Dividing stations
1

Resistance Method:          Manning's n
        SECTION                  A
     Low Stage n              0.055
     High Stage n             0.050
```

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)
0.36	T	0.79	2.90	2.65	0.25	0.28	0.059	0.055	1.29	0.95
[illegible]	T	0.76	2.92	2.66	0.26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			[illegible]	[illegible]	0.54	[illegible]	[illegible]	0.050	2.42	5.09
0.87	T	2.16	3.96	2.95	0.55	0.73	0.013	0.050	2.42	5.22
0.88	T	2.19	4.03	3.00	0.55	0.73	0.013	0.050	2.43	5.40
0.89	T	2.22	4.09	3.05	0.54	0.73	0.013			

2

TABLE 6-8. Bank erodibility hazard rating guide. (Rosgen, 1996)

B E H I

CRITERIA	VERY LOW		LOW		MODERATE		HIGH		VERY HIGH		EXTREME	
	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX
Bank Height Ratio	1.0-1.1	1.0-1.9	1.11-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
Root Depth/Bank Ht	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-0.05	8.0-9.0	<.05	10
Root Density (%)	80-100	1.0-1.9	55-79	2.0-3.9	30-54	4.0-5.9	15-29	6.0-7.9	5-14	8.0-9.0	<5.0	10
Bank Angle (Degrees)	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
Surface Prot. (%)	80-100	1.0-1.9	55-79	2.0-3.9	30-54	4.0-5.9	15-29	6.0-7.9	10-15	8.0-9.0	<10	10
TOTALS												
		5-9.5		10-19.5		20-29.5		30-39.5		40-45		46-50
Numerical Adjustments												

BANK MATERIALS: BEDROCK: BANK EROSION POTENTIAL ALWAYS VERY LOW
BOULDERS: BANK EROSION POTENTIAL LOW
COBBLE: DECREASE BY ONE CATEGORY UNLESS MIXTURE OF GRAVEL/SAND IS OVER 50%, THEN NO ADJUSTMENT
GRAVEL: ADJUST VALUES UP BY 5-10 POINTS DEPENDING ON COMPOSITION OF SAND
SAND: ADJUST VALUES UP BY 10 POINTS
SILT/CLAY: NO ADJUSTMENT

STRATIFICATION: 5-10 POINTS (UPWARD) DEPENDING ON POSITION OF UNSTABLE LAYERS IN RELATION TO BANKFULL STAGE

TABLE 6-9. Stress in the near-bank region, conversion of numerical indices to adjective ratings.

CONVERSION OF NUMERICAL INDICES TO ADJECTIVE RATINGS

Near Bank Stress Rating	Velocity Gradient***	A nb/A**	Near Bank Stress/Mean Shear Stress*
Low	1.0-1.2	.32 or less	.32 or less
Moderate	1.21-1.6	.33-.41	.3-.5
High ✓	1.61-2.0	.42-.45	.6-1.0
Very High	2.1-2.3	.46-.50	1.1-1.3
Extreme	2.4 or more	.51 or more	1.4 or more

* Near bank shear stress/mean shear stress (shear stress = depth*slope*water density)
** A = cross-sectional area; Near-bank cross-sectional area = width*depth* for 1/3 of the channel width in the near bank region.
*** Velocity gradient in ft/sec/ft is the difference in velocity from the core of velocity isovel along the orthogonal length to bank region in feet.

SURVEY DATA ⟹ CROSS - SECTION   Part 1

Date: [illegible]

Location: San Antonio above Jemez River

/ Notes:

Distance; Point; or STATION	Back-Sight B S	Height of Instrument H I	Fore-Sight F S	Height; Depth; or Elevation	NOTES COMMENT REMARKS

Cross-section

Distance	Adjusted Distance	Height		Adjusted Height	Notes	
46.0	0.0	3.32		100.00	LBP	at right bank
41.2	4.8	5.57		97.75		
36.3	9.7	6.01		97.31		
34.8	11.2	6.32		97.00		
30.9	15.1	6.60	0	96.72	LBF	full
27.8	18.2	7.22	.62	96.10	LWE	edge
27.3	18.8	8.46	1.86	94.86	Thalwag	
25.8	20.2	8.19	1.59	95.13		
23.4	22.6	6.50	0	96.82		
21.5	24.5	8.45	1.85	94.87		
16.5	29.5	7.94	1.34	95.38		
12.4	33.6	7.52	.92	95.80		
10.0	36.0	7.27	.67	96.05	RWE	
8.9	37.1	6.60	0	96.72	RBF	
5.8	40.2	3.33		99.99		twag
2.0	44.0	2.96		100.36		+ edge water
1.0	45.0	2.36		100.96		bkfull
0.0	46.0	2.14		101.18	RBP	

34.8	6.32	Break in slope
[illegible]	[illegible]	top of [illegible]
41.2	5.57	bottom bn slope
46.0	3.32	Left bank pin

42.7
4.4

4.74 [illegible]

step pool

SURVEY DATA ⟹ CROSS - SECTION   Part II

SITE: Date:

STATION	B S	H I	F S	Elevation

36
37
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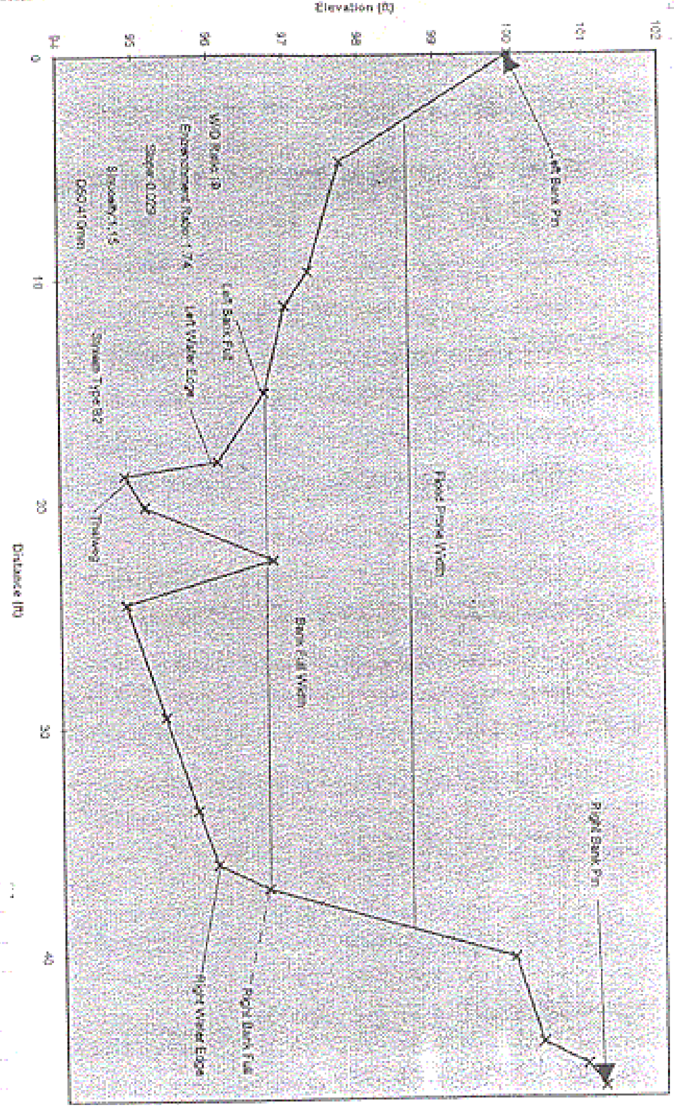


SURVEY DATA ⟹ LONGITUDINAL PROFILE — Part I

SAN ANTONIO ABV JEMEZ — Date:

Location:

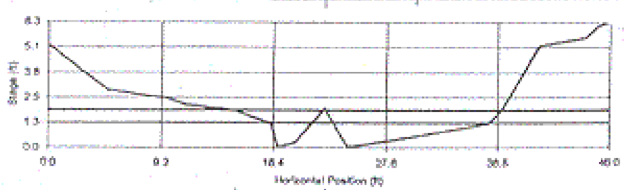
Notes:

Distance; Point; or STATION (Ft.)	Back-Sight B S (Ft.)	Height of Instrument H I (Ft.)	Fore-Sight F S (Ft.)	Height; Depth; or Elevation (Ft.)	NOTES / COMMENT / REMARKS

Conveyance Method: Thorne and Zevenbergen
[illegible]: 200.000 ##

E	WSEL	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DMAX (ft)	SLOPE (ft/ft)	n	VAVG (ft/sec)	Q (cfs)	SHEAR (psf)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

E	ALPHA	FROUDE
[illegible]	[illegible]	[illegible]



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SURVEY DATA ⟹ LONGITUDINAL PROFILE — Part II

SITE: — Date:

Item	STATION (Ft.)	B S (Ft.)	H I (Ft.)	F S (Ft.)	Elevation (Ft.)	NOTES / COMMENT / REMARKS
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THE REFERENCE REACH FIELD BOOK

RVEY DATA ⇒ CROSS - SECTION Part I

E: EAST FORK Abv SAN ANTONIO Date: 11/2/98

ation: @ PICNIC AREA above old foot Brdg

/ / Notes:

tance; Point; or STATION	Back-Sight (Rade-y) B S	Height of Instrument H I	Fore-Sight F S	Height; Depth; or Elevation	NOTES COMMENT REMARKS

s-Sections

nce	Adjusted Distance	Height	Adjusted Height	Notes	
84.0	0.0	3.12	100.00	LBP	RDB / ON FLAT / pin
77.0	7.0	5.80	97.32		Break slope
75.5	8.5	6.51	96.61	LBF	Bottom "
72.0	12.0	8.31	95.1 ~~94.81~~	LEW	
71.0	13.0	9.18	93.94		
68.7	15.3	9.42	93.70	Thalwag	depression
67.0	17.0	8.92	94.20		
65.0	19.0	9.01	94.11		
62.0	22.0	8.57	94.55		
59.0	25.0	8.91	94.21		
56.0	28.0	8.12	95.00		slope
53.0	31.0	8.62	94.50		B.F.
48.7	35.3	7.60	95.1 ~~95.52~~	REW	R.E.W. higher
45.0	39.0	6.51	96.61	RBF	H2O
42.0	42.0	5.99	97.13		"
39.0	45.0	5.46	97.66		"
34.0	50.0	5.91	97.21		"
30.0	54.0	5.88	97.24		
24.0	60.0	6.32	96.80		
21.0	63.0	5.84	97.28		
17.0	67.0	5.57	97.55		
10.0	74.0	6.32	96.80		
5.25	78.75	4.21	98.91		Max Depth
0.0	84.0	3.52	99.60	RBP	

D = 2.91

96.61

72.0	8.31	1.8	2.25	4.05	L.E.W.
75.5	6.51	0		0	B.F.
77.0	5.8			2:55.3	LDB
84.0	3.12	1.8			pin

Max Depth 2.91 IH 3.6 for Flood Prone

30.5 BFW

Flood Prone right 1' dist 3.6' Height

Left 81.8' 3.6

5.13 upper elev 200' tape .024

THE REFERENCE REACH FIELD BOOK 25

SURVEY DATA ⇒ CROSS - SECTION Part II

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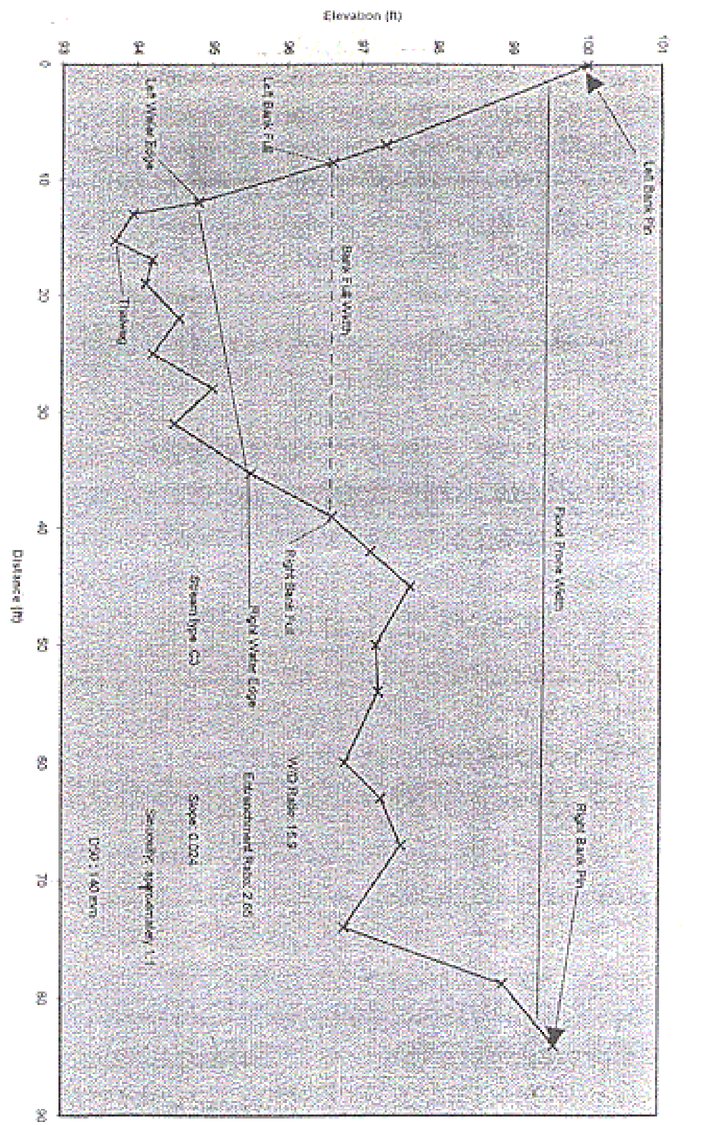


RVEY DATA ⟹ **LONGITUDINAL PROFILE** Part I

TE: EAST FORK ABV SAN ANTONIO Date:

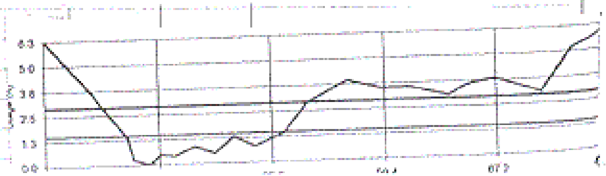
cation:

rty / Notes:

stance; Point; or STATION (Ft)	Back-Sight B S (Ft)	Height of Instrument H I (Ft)	Fore-Sight F S (Ft)	Height; Depth; or Elevation (Ft)	NOTES / COMMENT / REMARKS
					24.6

STAGE (FT)	RICE	AREA (SQ FT)	PERIM (FT)	WIDTH (FT)	R (FT)	DHYD (FT)	SLOPE (FT/FT)	N	VAVG (FT/S)	Q (CFS)	SHEAR (PSF)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STAGE	ALPHA	FROUDE
[illegible]	[illegible]	[illegible]



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SURVEY DATA ⟹ **LONGITUDINAL PROFILE** Part II

SITE: Date:

Item	STATION (Ft)	B S (Ft)	H I (Ft)	F S (Ft)	Elevation (Ft)	NOTES / COMMENT / REMARKS
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